

Epidemiological Profile of Burn Cases: An Autopsy-Based Study at Patna Medical College and Hospital, Patna

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Abstract:

Background: Burn injuries continue to be a major cause of preventable morbidity and mortality in developing nations, particularly in India, where domestic and sociocultural factors play a dominant role. Regional variations in burn patterns reflect differences in living conditions, fuel use, and safety practices.

Objectives: To determine the epidemiological and forensic characteristics of burn deaths subjected to medicolegal autopsy at Patna Medical College and Hospital (PMCH), Patna, over a two-year period.

Methods: This retrospective cross-sectional study analyzed 230 consecutive cases of burn-related deaths autopsied at PMCH during a 24-month period. Data were collected from postmortem reports, police requisitions, hospital records, and toxicological findings. Variables studied included demographic factors, residence, season, manner and mechanism of burns, total body surface area (TBSA), inhalational injury, and cause of death. Descriptive and inferential statistics were applied for analysis.

Results: Females constituted 58% of victims (female-to-male ratio 1.4:1), and the most affected age group was 21–30 years (42%). Rural residents accounted for 54% of cases. Domestic settings were the most common site (71%), primarily kitchens. Accidental burns formed 62% of cases, followed by suicidal (28%) and homicidal (6%). Kerosene-related accidents (40%) were the leading cause. Summer season showed peak incidence (38%). TBSA between 40–59% was most frequent (26%), with inhalational injury in 34%. Shock (44%) was the major cause of death. Suicidal burns were significantly higher among females ($p < 0.001$).

Conclusion: Burn mortality in this region predominantly affects young rural females due to domestic kerosene usage and unsafe cooking environments. Public education, safer fuel practices, early medical care, and social reforms addressing domestic violence are imperative to reduce such preventable deaths.

Keywords: Burn Injury; Epidemiology; Autopsy; Kerosene; Suicidal Burns; Forensic Pathology; Bihar; India

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Introduction

Burn injury is one of the most destructive and complex forms of trauma encountered in medical and forensic practice. It results not only in extensive physical tissue damage but also in deep emotional and socioeconomic consequences for the victim and family. Despite being largely preventable, burns continue to rank among the leading causes of injury-related deaths in developing countries. According to World Health Organization estimates, hundreds of thousands of individuals die each year from burn injuries, with India contributing a significant proportion of this global mortality. The high burden in India can be attributed to dense population, poverty, illiteracy, overcrowded housing, and unsafe cooking and heating practices. Many households still depend on open flames, kerosene stoves, and LPG cylinders without adequate safety measures. The pattern of burn injuries in India is influenced by

regional customs, climatic conditions, and socioeconomic status. Young adults—especially women in the reproductive age group—are particularly at risk due to their frequent involvement in household activities and exposure to open flames while cooking.

The epidemiology of burn deaths reflects a complex interaction between environmental hazards, social behavior, and cultural factors. Accidental burns during cooking, suicide by self-immolation, and homicidal burns related to domestic violence or dowry disputes constitute the major categories seen in medicolegal practice. Flame burns caused by kerosene and LPG accidents account for the majority of fatal cases, while scalds, electrical burns, and chemical burns form smaller fractions. The outcome of a burn injury depends on several

determinants such as the total body surface area (TBSA) involved, the depth of burns, inhalational injury, time taken to receive medical care, and presence of complications like shock or sepsis. Distinguishing the manner of death—whether accidental, suicidal, or homicidal—poses a major challenge for forensic experts, particularly when circumstantial evidence is ambiguous. In this context, postmortem examination remains the cornerstone for determining the cause and manner of death. Findings such as soot in the respiratory tract, carboxyhemoglobin levels, distribution of burns, and associated injuries help in differentiating antemortem burns from postmortem exposure and contribute to accurate certification of death.

The state of Bihar, with its predominantly rural population and dependence on traditional fuels, remains highly vulnerable to burn incidents. Patna Medical College and Hospital (PMCH) functions as a major referral center for both urban and rural districts and handles a considerable number of medicolegal autopsies every year. The diversity of its catchment population provides an opportunity to study the demographic, environmental, and forensic patterns of burn fatalities in this region. A detailed evaluation of autopsy records can reveal local trends, highlight vulnerable groups, and indicate gaps in preventive measures. The present study was undertaken to analyze the epidemiological characteristics of burn deaths at PMCH over a two-year period. The objectives were to assess demographic variables such as age, sex, residence, and season; to identify the prevailing manners and mechanisms of burns; to examine clinical and forensic indicators including TBSA and inhalational injury; and to determine the major causes of death. Insights gained from this study are expected to assist public health authorities, policymakers, and forensic professionals in formulating effective strategies for prevention, early management, and reduction of burn-related mortality in Bihar and similar settings across India.

Materials and Methods

Study Design and Setting: This was a retrospective descriptive and analytical study conducted in the Department of Forensic Medicine & Toxicology, Patna Medical College and Hospital (PMCH), Patna, over a period of 24 months.

Study Population: All cases where death was due to burns or complications of burns and subjected to

medicolegal autopsy at PMCH were included. A total of 230 cases formed the study sample.

Data Collection

Data were compiled from:

- Autopsy reports and inquest papers
- Hospital treatment records (where available)
- Toxicological analysis reports

The following parameters were analyzed:

- **Demographic details:** age, sex, residence, occupation, marital status
- **Incident characteristics:** place, season, mechanism, and manner of burns
- **Clinical/forensic findings:** TBSA, inhalational injury, soot in airways, cause of death
- **Toxicology:** carboxyhemoglobin and cyanide tests

Statistical Analysis: Descriptive statistics (frequency, percentage) and chi-square tests were applied for associations between categorical variables using SPSS software. A p-value <0.05 was considered statistically significant.

Results

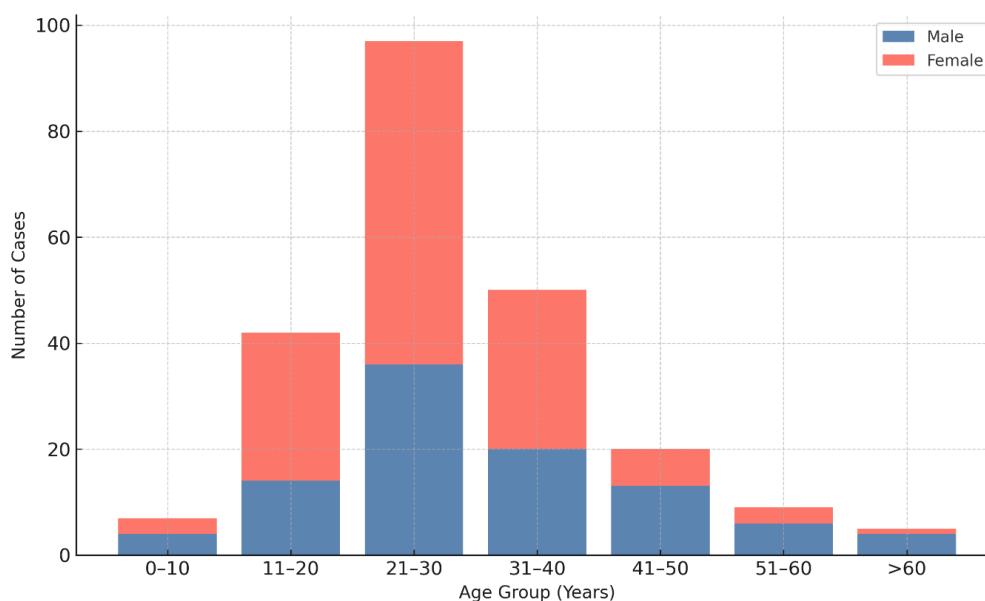
A total of 230 burn-related autopsies were examined during the two-year study period at the Department of Forensic Medicine and Toxicology, PMCH, Patna. The findings were analyzed in relation to demographic profile, environmental and circumstantial factors, clinical–forensic indicators, and causes of death.

Demographic Profile: Out of the total 230 cases, 133 (58%) were females and 97 (42%) were males, giving a female-to-male ratio of 1.4:1. The most affected age group was 21–30 years (42%), followed by 31–40 years (22%), indicating that young adults in the productive age range formed the majority of victims. The mean age among females was 27.6 years, while among males it was 34.2 years.

With respect to residence, 124 cases (54%) belonged to rural areas and 106 (46%) to urban localities. Socioeconomically, most victims came from lower and lower-middle income groups. The predominance of rural cases reflects the continued dependence on traditional fuels and limited access to safe cooking practices.

Table 1: Age and Sex Distribution of Burn Victims (n = 230)

Age Group (Years)	Male	Female	Total (%)
0–10	4	3	7 (3.0)
11–20	14	28	42 (18.3)
21–30	36	61	97 (42.2)
31–40	20	30	50 (21.7)
41–50	13	7	20 (8.7)
51–60	6	3	9 (3.9)
>60	4	1	5 (2.2)
Total	97 (42%)	133 (58%)	230 (100%)

Figure 1: Age and Sex Distribution of Burn Victims**Figure 1: Age and Sex Distribution of Burn Victims**

Place and Season of Occurrence: The majority of incidents occurred at home (71%), followed by public places (12%), workplaces (11%), and other locations (6%). Among domestic cases, 62% took place in the kitchen area, emphasizing the household origin of most burn injuries.

Seasonal variation showed the highest incidence during summer (38%), followed by monsoon (28%), winter (24%), and post-monsoon (10%) (Figure 2). The rise during summer months may be attributed to increased ambient temperature, low humidity, and volatility of fuels such as kerosene.

Figure 2: Seasonal Distribution of Burn Cases

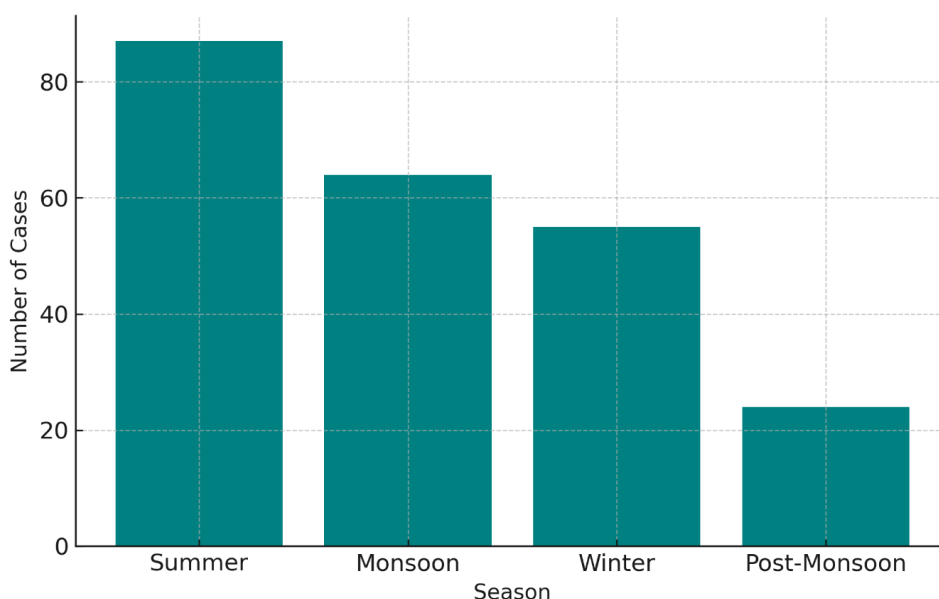


Figure 2: Seasonal Distribution of Burn Cases

Manner and Mechanism of Burns: The analysis of manner of death revealed that accidental burns constituted the largest group (143 cases; 62%), followed by suicidal burns (64 cases; 28%), homicidal burns (14 cases; 6%), and undetermined cases (9 cases; 4%). Female victims accounted for the majority of suicidal burns (36% of females) compared to males (17% of males), showing a statistically significant association ($\chi^2 = 11.47$; $p < 0.001$).

Regarding the mechanism of burns, kerosene stove and lamp accidents were the leading cause (40%), followed by house fires (22%), LPG cylinder explosions (18%), electrical burns (6%), scalds (5%), and others (9%) (Table 2). The widespread use of kerosene and defective handling of LPG cylinders contributed notably to domestic accidents.

Table 2: Distribution of Cases by Manner and Mechanism of Burns (n = 230)

Parameter	Category	Number of Cases	Percentage (%)
Manner of Death	Accidental	143	62.2
	Suicidal	64	27.8
	Homicidal	14	6.1
	Undetermined	9	3.9
Mechanism of Burn	Kerosene stove/lamp	92	40.0
	House fire	51	22.2
	LPG/Cylinder explosion	41	17.8
	Electrical	14	6.1
	Scalds	12	5.2
	Others	20	8.7

Clinical and Forensic Findings: The Total Body Surface Area (TBSA) involved ranged from 10% to 100%, with an average of 58.4%. Most victims (26%) had 40–59% TBSA, followed by 24% with 60–79%, and 16% with $\geq 80\%$ TBSA. The majority (73%) of burns were of mixed second and third degree. Inhalational injury was suspected in 34% of cases, while soot in the airways was observed in 31%, confirming ante-mortem exposure to smoke. Carboxyhemoglobin levels above 50% were

detected in 14% of cases tested, indicating fatal carbon monoxide inhalation.

In female victims, dowry-related or intimate partner violence was suspected in 18% (24/133) based on inquest and circumstantial evidence. Clothing ignition during domestic activities was reported in nearly half (49%) of all cases.

Survival Interval and Cause of Death: Out of all cases, 18% died at the scene, 27% within 24 hours, 24% survived for 1–3 days, 16% for 4–7 days, and

15% for more than 7 days after sustaining burns (Table 3). Higher TBSA (>60%) showed a strong correlation with early death ($p < 0.001$).

The leading cause of death was hypovolemic or thermal shock (44%), followed by sepsis and multiorgan dysfunction (28%), acute respiratory distress syndrome (14%), carbon monoxide poisoning (9%), and electrical arrhythmia (3%).

Table 3: Survival Period and Cause of Death in Burn Victims (n = 230)

Variable	Category	Number of Cases	Percentage (%)
Survival Interval	Died on spot	41	17.8
	<24 hours	62	27.0
	1–3 days	55	23.9
	4–7 days	37	16.1
	>7 days	35	15.2
Cause of Death	Shock (thermal/hypovolemic)	101	43.9
	Sepsis/MODS	65	28.3
	ARDS/respiratory failure	33	14.3
	CO poisoning	21	9.1
	Electrical arrhythmia	7	3.0
	Others	3	1.3

Figure 3: Distribution of Causes of Death in Burn Victims

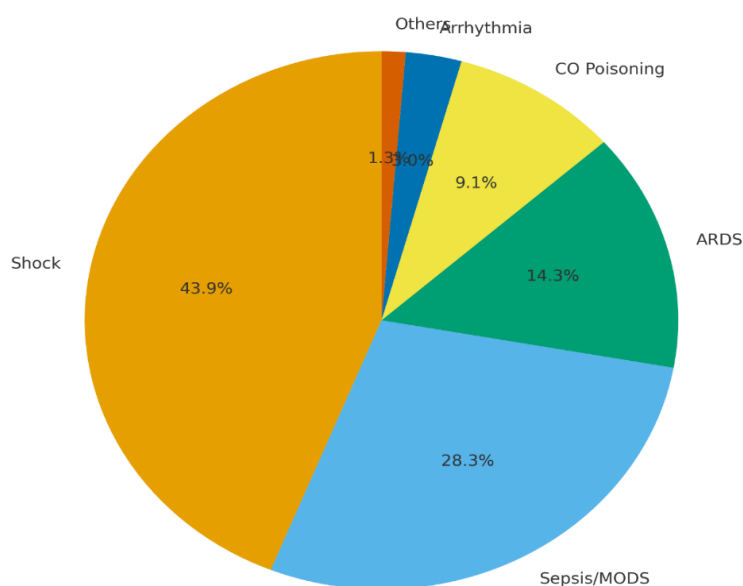


Figure 3: Illustrates the distribution of causes of death among burn victims

Discussion

The present study analyzed 230 autopsy-confirmed cases of burn deaths conducted over a period of two years at Patna Medical College and Hospital, Patna. The findings provide valuable insight into the current pattern of burn fatalities in this region and reflect the combined influence of social, environmental, and behavioral factors. Burn injuries remain a significant public health problem in India, causing heavy loss of life and productivity every year. Despite improvements in hospital care, preventive education, and safety measures, burns

continue to rank among the leading causes of unnatural deaths, particularly among young adults. The present analysis confirms that burns are not merely accidental events but the outcome of multiple interacting factors including unsafe domestic environments, social pressures, and inadequate medical response systems.

A clear age and sex disparity was observed in the present series. The maximum number of victims were in the age group of 21 to 30 years, constituting over two-fifths of the total cases. Females outnumbered males, forming about three-fifths of all

burn deaths. This demographic pattern mirrors the social realities of Indian society, where women in the reproductive and marital age group are more frequently exposed to open flames during cooking and household work. The tendency for burns to occur in this age group also reflects the social tensions and psychological stress prevalent among young adults. Many female victims were newly married, highlighting the continuing vulnerability of women in domestic settings. Males, in contrast, were more often victims of accidental and occupational burns, particularly electrical and industrial incidents. The predominance of rural residents indicates that poverty, traditional cooking fuels, and lack of safety awareness remain important contributors to the high burn mortality in Bihar.

The environmental and seasonal distribution of cases adds another dimension to understanding burn injuries. In this study, the majority of incidents occurred during the summer months, followed by monsoon and winter. The higher incidence during summer may be attributed to elevated ambient temperature, dryness of the atmosphere, and increased volatility of fuels such as kerosene and LPG. Loose-fitting synthetic clothing, which easily ignites, further increases vulnerability during this period. Domestic fires accounted for nearly three-fourths of all cases, and most of them originated in kitchens or sleeping areas. These findings highlight the continued risks associated with domestic cooking practices and inadequate housing arrangements. Poor ventilation, overcrowded homes, and the use of unsafe kerosene stoves are persistent problems in rural households, which have not been adequately addressed despite the availability of safer alternatives like LPG. Seasonal variation and domestic predominance both point to preventable causes that can be mitigated through public education and simple environmental modifications.

The analysis of the manner of death showed that accidental burns formed the majority, followed by suicidal and a small proportion of homicidal cases. Accidental burns were mainly due to kerosene stove explosions, overturned lamps, and leakage of LPG cylinders. These accidents often occurred in confined kitchen spaces with limited ventilation, resulting in rapid flame spread and high fatality. Suicidal burns, observed predominantly among young women, were usually associated with domestic conflicts, mental distress, and dowry-related harassment. The act of self-immolation continues to be a tragic expression of social suffering among women in distress. Homicidal burns, though less common, were encountered in cases where the body was set ablaze to conceal other crimes such as murder or sexual assault. The medicolegal differentiation between suicidal and accidental burns often poses a challenge,

particularly in cases lacking witness accounts or adequate circumstantial evidence. Careful evaluation of burn pattern, distribution, and associated injuries during autopsy remains essential to reach a fair conclusion regarding the manner of death.

Clinical and forensic evaluation of burn victims provided further depth to the findings. The total body surface area involved ranged from 10% to complete burns, with an average of around 58%. Fatal outcomes were more frequent in victims with extensive burns exceeding 60% of body surface area. Early deaths were mainly due to burn shock, while delayed mortality was related to infection, septicemia, or respiratory failure. Inhalational injury was suspected in about one-third of the cases, and the presence of soot in the airways in several victims confirmed ante-mortem exposure to smoke. Detection of elevated carboxyhemoglobin levels in some cases further indicated death due to carbon monoxide inhalation in enclosed fires. These findings reaffirm the importance of detailed internal examination and toxicological testing in all burn cases. The presence or absence of soot and gas inhalation serves as a reliable indicator for distinguishing whether the burns were sustained before or after death.

The medicolegal implications of the present findings are significant. In a considerable number of female victims, circumstantial evidence suggested the possibility of dowry-related or intimate partner violence. Such cases, though difficult to prove conclusively, highlight the dark intersection between gender violence and burn mortality in India. Forensic investigation in these cases demands meticulous coordination between medical examiners, police authorities, and the judiciary. Every burn death, especially involving a married woman within seven years of marriage, should be investigated under existing legal provisions to rule out foul play. Proper documentation of injuries, photographic evidence, and chemical analysis of viscera play a decisive role in ensuring justice. The study also reinforces the importance of comprehensive toxicological examination in suspected homicidal or suicidal burns. Detection of substances such as kerosene residues, alcohol, or sedatives may assist in reconstructing the sequence of events leading to death.

Comparison with previous Indian studies reveals similar patterns across most regions of the country. Research from Delhi, Lucknow, and Chennai has shown that the majority of burn deaths occur among young females in domestic settings, with kerosene-related accidents forming the largest subgroup. The findings from PMCH are consistent with this national trend but also reflect the distinct socioeconomic realities of Bihar, where rural poverty and dependence on traditional fuels remain

high. While government initiatives such as LPG distribution schemes have improved fuel safety in some urban areas, their penetration into rural households remains limited. Education regarding proper use and maintenance of gas cylinders and stoves is often lacking. Strengthening community-based fire safety programs, promoting fire-retardant clothing, and ensuring wider access to safe fuels could significantly reduce the burden of accidental burns. Early hospital referral, timely fluid resuscitation, and infection control are equally crucial for reducing mortality in patients who survive the initial injury.

Although the study provides valuable insight into the pattern of burn deaths in this region, certain limitations are acknowledged. Being retrospective and autopsy-based, it relied on available records, and some data on pre-hospital care and social circumstances were incomplete. Toxicological analyses were not performed in all cases due to logistical constraints. Despite these limitations, the findings remain representative of the prevailing situation in central Bihar, given the large sample size and systematic analysis. The study emphasizes that most burn deaths are preventable through better safety awareness, community participation, and strong enforcement of social laws. Public education on household fire safety, regulation of fuel distribution, and psychological counseling for women in distress could play an important role in prevention. Establishing specialized burn care units at district hospitals, training personnel in burn management, and promoting forensic standardization of autopsy practices will further strengthen the system.

In conclusion, the pattern of burn deaths observed at Patna Medical College and Hospital reflects a preventable tragedy deeply rooted in domestic hazards and social inequities. Young females remain the most affected group, and accidental burns related to kerosene use continue to dominate despite technological progress. The co-existence of accidental, suicidal, and homicidal burns highlights the multidimensional nature of the problem. Effective prevention will require a coordinated approach combining education, legislation, and healthcare reform. By identifying the key risk factors and understanding the local trends, this study hopes to contribute to a more informed and proactive response to the problem of burn fatalities in Bihar and across India.

Conclusion

Burn injuries remain a major cause of preventable mortality, particularly among young adult females in domestic settings. This autopsy-based analysis at Patna Medical College and Hospital demonstrated that most burn deaths were accidental, frequently related to kerosene and LPG use, with a notable

proportion linked to suicidal intent and domestic violence. Extensive burns, inhalational injuries, and delayed medical intervention were key factors contributing to fatal outcomes. The findings highlight the urgent need for public education on fire safety, safer cooking practices, and timely medical referral. Strengthening rural healthcare infrastructure, establishing specialized burn care units, and enforcing laws against domestic violence and dowry-related abuse are essential preventive strategies. Coordinated community awareness and legal action can substantially reduce the burden of burn-related deaths and improve overall safety and justice for vulnerable populations in this region.

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